SSL EVALUATION:

OLED Lighting in the Offices of Aurora Lighting Design, Inc.

The first GATEWAY demonstration involving OLEDs is also the first office test site for the use of OLEDs in general lighting.

The office of Aurora Lighting Design, Inc., with its lighting system using OLED panels. *Photo courtesy of Acuity Brands.*

In March 2014, Aurora Lighting Design, Inc., in Grayslake, IL, made the bold decision to install an OLED lighting system during office renovations. Aurora is a small architectural lighting design office located in the lower level of a residence. With large windows overlooking a lake, the office uses daylight as its principal light source, supplementing with electric lighting for general and task lighting on heavily overcast days and outside of daylight hours. Intrigued with OLED panels because of their soft appearance and shallow profile, Aurora changed out its existing recessed downlights in favor of Acuity Brands' Trilia™ system in September 2014. At the time, OLED panels and drivers had a short track record. The technology was still very new, and there was little solid information about panel and driver life, lumen maintenance, and dimming compatibility. With the September 2014 installation, Aurora became the first office test site for the use of OLEDs in general lighting.

Eleven driver boxes installed on a wall separating Aurora's office from the storage room. *Photo: Leslie North.*

Intriguing Advantages

Aurora was intrigued with the playful pattern options offered by the Trilia system, whose shallow profile works well with the company's low-ceiling space, and which offers comfortable ambient light, with warm color (3000K) and very good color rendering (CRI = 89). Compared to the previous installation of recessed medium-base downlights with nominal 20W PAR38/830 LED lamps, the OLED system delivers much higher-quality lighting, according to the staff. The exposed OLED panels deliver a soft, minimal-shadow light that makes faces and expressions visible and increases room brightness by reaching vertical surfaces. When the OLED surface luminance (i.e., "brightness") is controlled, this is achieved with no increase in glare.

The system's appearance expresses creativity and innovation, making a statement to clients who visit the offices. What's more, the system is dimmable, enabling Aurora to save energy, reduce output and potential visual discomfort when lower illuminances are preferred, and use daylight as the prominent light source. Lighting-energy use is moderate, at 0.62 W/ft^2 when the system operated at full output with the correct drivers. Aurora's staff enjoys working under the system, and uses it in a dimmed state most of the time.

A Number of Challenges

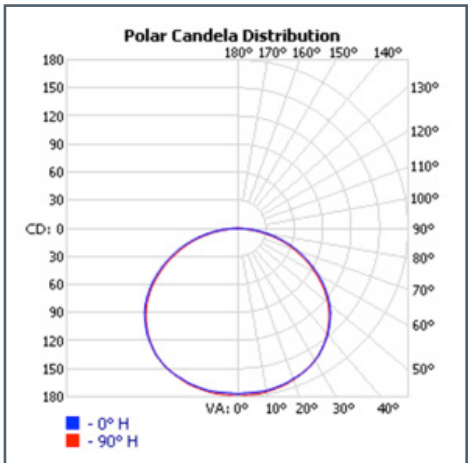
However, the installation of the OLED system at Aurora was not without its challenges and complications. The mounting and wiring details were unfamiliar to the electrical contractor and required pulling large numbers of wires through a hard ceiling to multiple mounting points. There are no dedicated OLED drivers on the market yet, so Acuity equipped the OLED lighting system with LED drivers, which lowered system efficacy because they can't be precisely tuned to the specific electrical needs of the OLEDs. Eleven separate remote drivers were needed to power this relatively small system, and their size necessitated mounting them in the next room. While the system dims smoothly with a 0-10V dimmer, dimming introduces flicker—although this may only be an issue for very sensitive occupants and visitors, since the flicker frequency appears to be well above 120 Hz.

Aurora's OLED installation is an important demonstration of the potential performance of OLED panels. The panel technology itself is maturing, and

problems such as shorting defects are already being solved with new panel architectures. The system that was installed in September 2014 represents the technology's state of the art at that time, with a system efficacy of around 46 lm/W. Two manufacturers have since promised 80-lm/W OLED panels for delivery in 2016 and higher efficacies soon afterward.

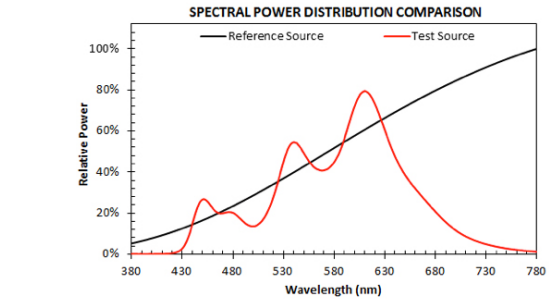
Driver Wanted

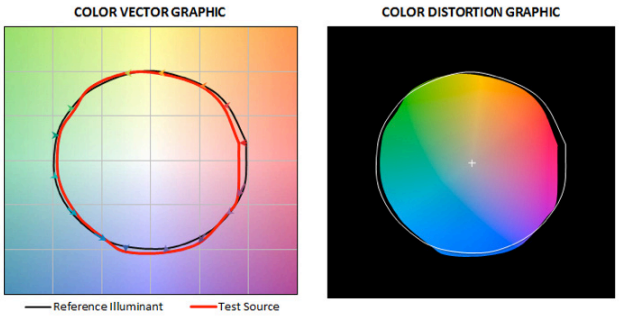
However, panel efficacy is only part of the story of OLED systems. One frustration of luminaire manufacturers is that there are no dedicated OLED drivers on the market, because the total demand in the architectural market is low. Instead, manufacturers have to work with LED drivers, customizing them as best they can to deliver the current and voltages needed, which are often outside the optimized efficiency range of the driver. This makes the driver a weak point in the system efficacy.



Polar plot of the photometric distribution from an eight-panel straight assembly of the Acuity Trilia™ OLED lighting system. The blue and red lines represent the 0° and 90° measurement planes and are nearly identical. *Source: Acuity Brands' Winona® Lighting, Test Report LTL25137.*

R_f	86
R_g	98
CCT (K)	2974
D_{uv}	0.0019
x	0.4417
y	0.4105
CIE R_a	89





Spectral power distribution, color metrics, and color-rendering graphics for the 3000K OLED panels.

The OLED panels are thin and light in weight, and they deliver a unique quality of light. However, the drivers are still relatively large and brick-like. Because they don't fit gracefully into the OLED luminaires or mounting canopies, they must be mounted remotely, which creates extra work for the designer and contractor to find an accessible location hidden from normal view, where drivers can be located in compliance with the electrical code. If OLEDs are to fulfill their promise, driver elements will need to be integrated sleekly and discreetly into the luminaire or mounting elements.

The flicker from OLEDs is a function of the driver, just as it is for LEDs. As with many performance aspects, such as dimming, it can be compounded by the fact that the driver, designed for LEDs, may be operating outside its optimal operating area. This can be corrected by an improved electronic circuit design. Acuity Brands has already been converting its OLED product line to a different brand of programmable driver that will have current ranges appropriate for the OLEDs, with improved dimming performance and dramatically higher light-modulation frequency to eliminate flicker complaints.

For full viability of OLED architectural lighting, the systems will need to deliver higher efficacy, better system components, and lower costs. OLED lighting is in its infancy compared to LED lighting, but the architectural market is taking notice of a lighting product with an entirely different look and function. If OLEDs continue to increase in efficacy, longevity, size, and flexibility, designers and engineers will have a new tool for creative and effective lighting.

Final reports on GATEWAY outdoor demonstration projects are available for download at http://energy.gov/eere/ssl/gateway-demonstration-outdoor-projects.

GATEWAY Demonstrations

GATEWAY demonstrations showcase high-performance LED products for general illumination in commercial, municipal, and residential applications. Demonstrations yield real-world experience and data on the performance and cost effectiveness of lighting solutions. For more information, see http://energy.gov/eere/ssl/gateway-demonstrations.

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